4K88-27

ANNUAL REPORT:

TERROR LAKE HYDROELECTRIC PROJECT

1987 SALMON EGG AND FRY SURVIVAL, ESCAPEMENT MAGNITUDE AND SPAWNER DISTRIBUTION

By:

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and

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PROJECT SPONSORSHIP

This investigation was partially funded by the Kodiak Electric Association and the Alaska Power Authority. (A breakdown of project expenditures is included in Appendix A.)

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ABSTRACT

The pre-emergent fry indices on the Terror River were some of the best on record, and those on the Kizhuyak River were also generally good. These combined with mild spring climatic conditions in 1987 predict an average to above average pink salmon return in 1988. The estimated total pink salmon escapement in 1987 was 72,000 in the Terror River and 47,000 in the Kizhuyak River. The estimated total chum salmon escapements in 1987 were 15,000 in the Terror River and 17,000 in the Kizhuyak River. These are at or above average escapements for these rivers.

Key Words: Terror Lake Hydroelectric Project, Salmon, Oncorhychus, Pre-emergent fry, Spawning distribution, Escapement

INTRODUCTION

Prior to development of the Terror Lake hydroelectric project potential beneficial and detrimental impacts on the salmon populations of the Terror River and Kizhuyak River were identified (AEIDC, 1981). Changes in stream flow and temperature directly affect salmon spawning and egg survival. In 1981 the Alaska Department of Fish and Game (ADF&G), Commercial Fisheries Division (CFD), entered into an agreement with the Kodiak Electric Association (KEA) to assess the magnitude of change, if any, in the pink salmon (Oncorhynchus gorbuscha) and chum salmon (Oncorhychus keta) populations in these two rivers. Study began in 1982 to measure pre-project levels of spawning and egg survival and have continued through facility construction and subsequent operations. Specifically, CFD wishes to evaluate (1) salmon egg and fry survival, (2) timing of salmon fry emergence; and (3) trends in salmon escapement magnitude and spawner distribution.

The Terror and Kizhuyak Rivers are located in north central Kodiak Island (Figure 1). The areas of study encompassed approximately the lower 1.5 miles of each river. The Terror River extends some 7.5 miles, running down from Terror Lake (Figure 2). An earthen and concrete dam was constructed at the lake outlet to increase the lake's volume and control outflow. A 5 mile tunnel was drilled to divert water down to a powerhouse in the Kizhuyak Basin.

It should be noted that data collected during the CFD annual studies may not necessarily be conclusive enough to assess specific changes within the salmon populations in question (Malloy 1981). An interim data analysis report will be completed in the fall of 1988, and a final report will be prepared after the end of the study period in 1991. This report details the efforts of CFD during the 1987 season.

PRE-EMERGENT FRY SAMPLING

Methods and Procedures

Pre-emergent fry sampling involved hydraulically excavating sac fry and eggs from spawning habitat. Sampling locations for both rivers are shown in figures 3 and 4. Personnel and equipment were transported to the sites with a Bell Long Ranger helicopter. Ten samples were collected at each pre-selected sampling area. For each sample a circular collection frame, two feet in diameter, was placed on the stream bed circumscribing the area to be excavated. A Homelite XLS pump forced an air/water mixture through a steel probe which was manually worked into the stream bed. All light materials, including eggs and fry, that bubbled

up out of the gravel were swept by the current into a tapered net attached to the downstream side of the collection frame. The net was emptied into a plastic bin and the fry and eggs identified and counted. Fry development, as indicated by the percent absorption of the yolk sac, was noted. A relative index of live fry abundance was developed for each portion of the river sampled.

Results

Terror River

Sampling was accomplished between 31 March and 5 April 1987. The live fry indices for this river were some of the best on record, particularly those on mainstream Terror and in the intertidal areas (Table 1). Spring climatic conditions were mild in 1987, which should be favorable to fry emergence and rearing. Combined, these factors predict an above average return for 1988.

Kizhuyak River

Sampling was accomplished between 30 March and 4 April 1987. The live fry indices on this river were more variable compared to past indices. The lower stretches of the drainage, specifically lower Chum Channel and lower mainstream Kizhuyak, had high indices (Table 2). Combined with the mild spring these predict an average to above average return in 1988.

ESCAPEMENT MAGNITUDE AND DISTRIBUTION

Methods and Procedure

Escapement enumeration and spawner distribution mapping was conducted by aerial survey from small fixed wing aircraft (Cessna 206, Supercub). Surveys were attempted twice weekly through the duration of spawning, as weather permitted. On each flight the observer estimated the number of each salmon species in the bays, intertidal zones, and the river systems. Pink salmon season escapements were figured by adding the highest counts 30 or more days apart. For example, for a particular river a high escapement count of 10 august could be added to a high count of 18 September to arrive at a total indexed escapement estimate for the season[1]. Chum salmon escapement estimates are made from the peak counts at each system. These counts also serve as a reliable index of total escapements. Both types of escapement

[1]CFD calculated indexed escapements for all major pink salmon systems in a similar manner.

estimates are comparable from one year to the next. Spawner distribution was also noted during aerial surveys, and was recorded on a 1:24,000 field map. A foot survey of each river system was to be conducted near the peak of spawning to further document species magnitude and distribution. Unfortunately, because of weather and the extended weir camp operations the foot surveys were not conducted in 1987.

Results

Terror River

Aerial survey data are listed in Table 3. The indexed pink salmon escapement, estimated by combining high counts made on 10 August and 8 September 1987 was 72,000 fish. This indexed escapement is well above the odd-year averages of 51,700 fish (Table 4). The peak chum salmon escapement count was made on 8 September 1987 at 15,000 fish. This is the highest escapement since the beginning of this study (Table 5).

Spawning distribution is shown in Figures 5 and 6. Distribution showed little change from previous years, with spawners utilizing the good spawning habitat (D. Prokopowich, Alaska Department of Fish and Game, Kodiak, personal communication).

Kizhuyak River

Aerial survey data are listed in Table 6. The indexed pink salmon escapement, estimated by combining high counts made on 10 August and 8 September 1987 was 47,000 fish. This was well above the odd-year average of 19,000 fish (Table 4). The peak chum salmon count was made on 8 September at 17,000 fish. This is near the average escapement of 17,195 chums (Table 5).

Spawner distribution is shown in Figures 7 and 8. Chum salmon were well distributed throughout the spawning habitat (L. Malloy, Alaska Department of Fish and Game, Kodiak, personal communication).

Table 1. Terror River pre-emergent fry sampling results, 1982-1987.

Sample location	Number Samples	Sample Dates	Live[1] Fry	Live[1] Eggs	Dead Fry	Dead Eggs	1987 Index LF/m^2*	1986 Index LF/m^2*	1985 Index LF/m^2*	1984 Index LF/m^2*	1983 Index LF/m^2*	1982 Index LF/m^2*	% Samples With Fry	Range of Fry Development	H^2O Temp. °C	Comments
Lower Terror SW Fork Intertidal	10	4/2/87	1066P	0	0	460	573.51P	73.17P	70.42P 0.54CH	0	240.49P	17.75P	100	.60 - .95	2°	
Lower Terror N.E. Intertidal	10	4/2/87	977P 150CH	0	23	91	525.63P 278.81CH	0	185.61P	372.71P 415.98CH	0	569.74P 156.56CH	100	.98 - .95	3°	
Upper Terror Thermograph	10	4/2/87	190P	0	0	2	102.22P	0	501.95P	0	15.60P	0	30	.99	3°	
Ouzel Creek	10	4/2/87	119P 1CH	0	0	9	64.02P 0.54CH	0		2.15P	0	8.07P 2.69CH	60	.99	4.5°	Emergent fry in creek. 5 Dolly Varden fry.
Bear Creek	N/S	-	-	-	-	-	-	230.8P	0	31.74P	0.54CH	N/S	-	-	-	Beaver dammed
Consternation Creek	10	4/2/87	0	0	242	10	0	0	0	0.54P 227.51CH	1.61P 0.54CH		100	-	2°	
ADF&G sample sites Mainstream Terror	50	3/31/87	660P	0	3	1,462	71.02P	.22P	107.60P	2.04P 5.70CH	22.38P	25.93P	56	.80 - .99	4°	Some eggs eyed up.

[1]P denotes pink; CH denotes chum.

*LF denotes live fry.

Table 2. Kizhuyak River pre-emergent fry sampling results, 1982-1987.

Sample location	Number Samples	Sample Dates	Live[1] Fry	Live[1] Eggs	Dead Fry	Dead Eggs	1987 Index LF/m^2	1986 Index LF/m^2*	1985 Index LF/m^2*	1984 Index LF/m^2*	1983 Index LF/m^2*	1982 Index LF/m^2*	% Samples With Fry	Range of Fry Development	H^2O Temp. °C	Comments
Lower Chum Channel	10	4/4/87	1,318P	0	0	244	709.08P	23.13P	76.39P	112.98P 20.44CH	0	393.82P	100	.9 - .95	4°	
Kizhuyak River Above Chum Channel	10	4/4/87	152P	0	0	16	81.78P	117.82P	1.05P	146.87P	-	-	60	.9 - .99	4°	
Kizhuyak River Below Chum Channel	10	4/4/87	432P	0	0	20	232.42P	-	-	N/S	5.92P	97.92P	90	.9 - .95	5°	
Kizhuyak River East Fork	10	4/4/87	0	0	0	0	0	0	266.84P	0.54P	1.61P	0	0		4°	
Kizhuyak River above Forks above Watchout	10	4/4/87	72P	0	0	6	38.74P	2.69P	-	0	0	0	60	.99	4°	
ADF&G sample sites Beaver Pond Creek	40	3/30/87	12P	0	0	61	1.61P	171.22P	8.61P	493.48P	53.8P	1042.78P 11.23CH	3	.90	4°	

[1]P denotes pink; CH denotes chum.

*LF denotes live fry.

Table 3. Terror River aerial survey results, 1987.

MANAGEMENT AREA: Kodiak

STREAM NUMBER: 253-331

STREAM NAME: Terror River

FOR YEAR: 1987

MANAGEMENT SECTION:

Survey Dates	Observer	*	Visibility P	F	G	E	Fish in Stream REDS	COHO	PINK	CHUMS	Build-up Fish MOUTH	BAY	OBSERVER REMARKS
7/8	Malloy	A		X					800				Good water flow. Bay moderately turbid. Looks light.
7/9	Malloy	A										1,000P	Bay looks bleak, should be noticeable build-up by now.
7/11	Malloy	A		X									Surveyed entire river. Light turbidity in stream.
7/14	Malloy	A		X						150			Good water flow. Two jumpers in bay. Should be pinks in stream.
													No schooled fish in build-up holes
7/15	Malloy	A		X									River mildly turbid; a lot of runoff. Estuary also turbid. No sign of fish.
7/21	Prokopowich	A	X										River and Bay silty and muddy.
7/23	Malloy	A	X										Heavy runoff-river and bay very muddy.
7/26	Malloy	A	X										Heavy runoff has totally muddied bay and river.
7/28	Malloy	A	X						900	150		2,000P	Should be more fish in bay and river.
7/28	Prokopowich	A		X					2,500	8,000		25,000P 2,500C	Good show of incoming fish along east side of bay inside markers.
8/3	Prokopowich	A			X				12,000	5,000		25,000P	
8/7	Prokopowich	A		X					5,000	5,000		15,000P	
8/10	Malloy	A		X					16,000	6,000		26,000P	Stream medium high flow. Pinks distributed in sampling areas. Chum above and in sloughs.
8/16	Malloy	A		X					21,000	5,500		18,000P	
8/18	Brown	A			X				14,600		10,000P		Poor stream survey due to other low flying aircraft.
9/8	Prokopowich	A				X			60,000	15,000			Good distribution and water flow.
10/9	Chatto	A			X			50					Surveyed from flats to 3.5 miles upstream. All coho in hole 1/2 mi upstream

Table 3a. Footnotes for Understanding Salmon Escapement Data

1. * : Indicates the following survey methods: A=Aerial, F=Foot, W=Weir

2. Visibility: Indicates water visibility in the following categories:

   S=Stream M=Mouth B=Bay A=All three categories or any two categories

3. Fish in Stream:

   \- : Stream not surveyed for this species.

   0 : Stream surveyed for this species, none observed.

   N : Any numerical designation reflects indexed number of live fish observed; portion of stream surveyed includes 100% of fish in stream for survey date. Any deviations from this are denoted in comments, e.g. carcasses and percentage of system surveyed for that portion of stream expected to contain fish for a specific survey date.

4. Categories of Fish Occurrence

   a/STREAM: Fish which occur and remain within the spawning area of a stream or which occur in a freshwater portion of a stream during spawning migration; this will also include fish observed in the mouth on the last survey of the year. These fish are not vulnerable to normal illegal fishing methods and means.

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   b/MOUTH: Build-up of fish in saltwater which is normally closed to commercial fishing. These fish generally are not vulnerable to legal fishing, but they may be vulnerable to illegal fishing. This category includes designated lagoons, as described in the closed waters portion of the Commercial Fishing Regulations. These fish are considered to be homing in on the stream for which they are documented and will be counted as fish in the stream on the last survey of the year.

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   c/BAY: Build-up fish, in saltwater which is normally either open to commercial fishing or closed to commercial fishing (closed water sanctuaries), which may be at least partially vulnerable to both legal and illegal fishing. These fish will not be included in the stream count unless special denotation is made in the remarks column and will only apply on the last survey of the year.

5. Species Abbreviations

   K = Kings
   R = Reds
   C = Coho
   P = Pinks
   D = Dogs

Table 4. Odd-year pink salmon escapements, Terror and Kizhuyak Rivers, 1961-1987.

Year	Terror River Escapement	Kizhuyak Escapement
1961	22,000	8,000
1963	79,500	9,000
1965	17,300	3,700
1967	24,700	8,950
1969	46,000	8,700
1971	40,000	4,000
1973	22,000	8,300
1975	43,500	11,000
1977	56,000	19,300
1979	80,000	29,600
1981	92,000	55,250
1983	42,250	18,000
1985	86,800	35,800
1987	72,000	47,000
	$\bar{X}$ 51,700	$\bar{X}$ 19,000

Table 5. Chum salmon escapements, Terror and Kizhuyak Rivers, 1982-1987.

Year	Terror River Escapement	Kizhuyak River Escapement
1982	12,900	12,000
1983	10,050	3,170
1984	10,000	9,000
1985	3,000	7,000
1986	10,000	55,000
1987	15,000	17,000
	$\bar{X}$ 10,158	$\bar{X}$ 17,195

Table 6. Kizhuyak River aerial survey results, 1987.

MANAGEMENT AREA: Kodiak FOR YEAR: 1987

STREAM NUMBER: 259-365 STREAM NAME: Kizhuyak River MANAGEMENT SECTION:

Survey Dates	Survey Observer	*	Visibility P	Visibility F	Visibility G	Visibility E	Fish in Stream REDS	Fish in Stream COHO	Fish in Stream PINK	Fish in Stream CHUMS	Build-up Fish MOUTH	Build-up Fish BAY	OBSERVER REMARKS
7/15	Malloy	A				X						800	Water flow good. Early sign of chums in bay.
8/10	Malloy	A			X				11,000	3,600	2,000P 4,000C	16,000P 51,000C	Stream flow excellent for mainstem chum fork and all sloughs.
9/18	Prokopowich	A				X		150	36,000	17,000			50% pinks and chums are mortalities.
10/29	Brown	A		X				15					15 coho at Watchout Creek

Figure 1. Location of Terror River and Kizhuyak River, Kodiak Island, Alaska.

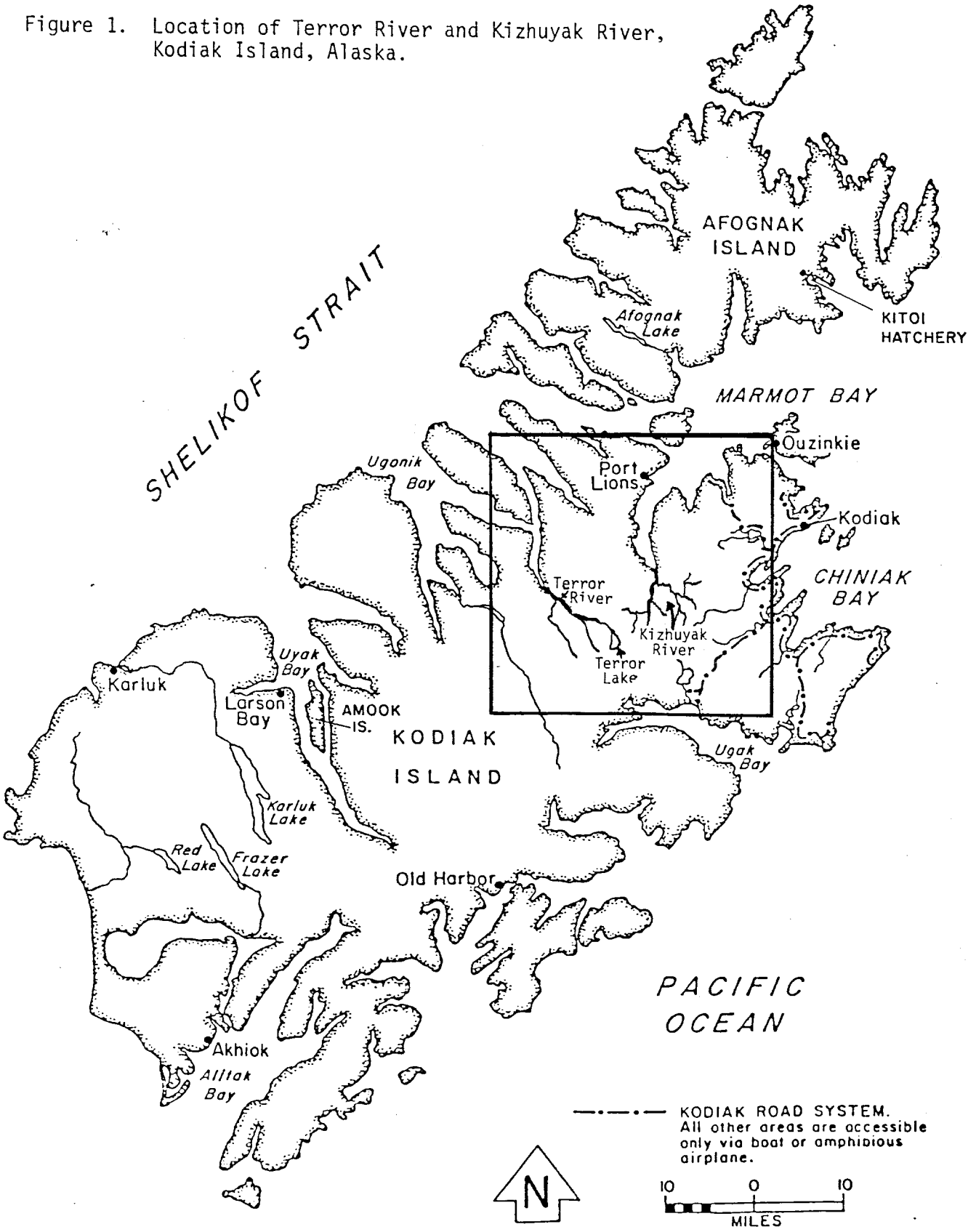


Figure 2. Terror Lake Hydroelectric Project.

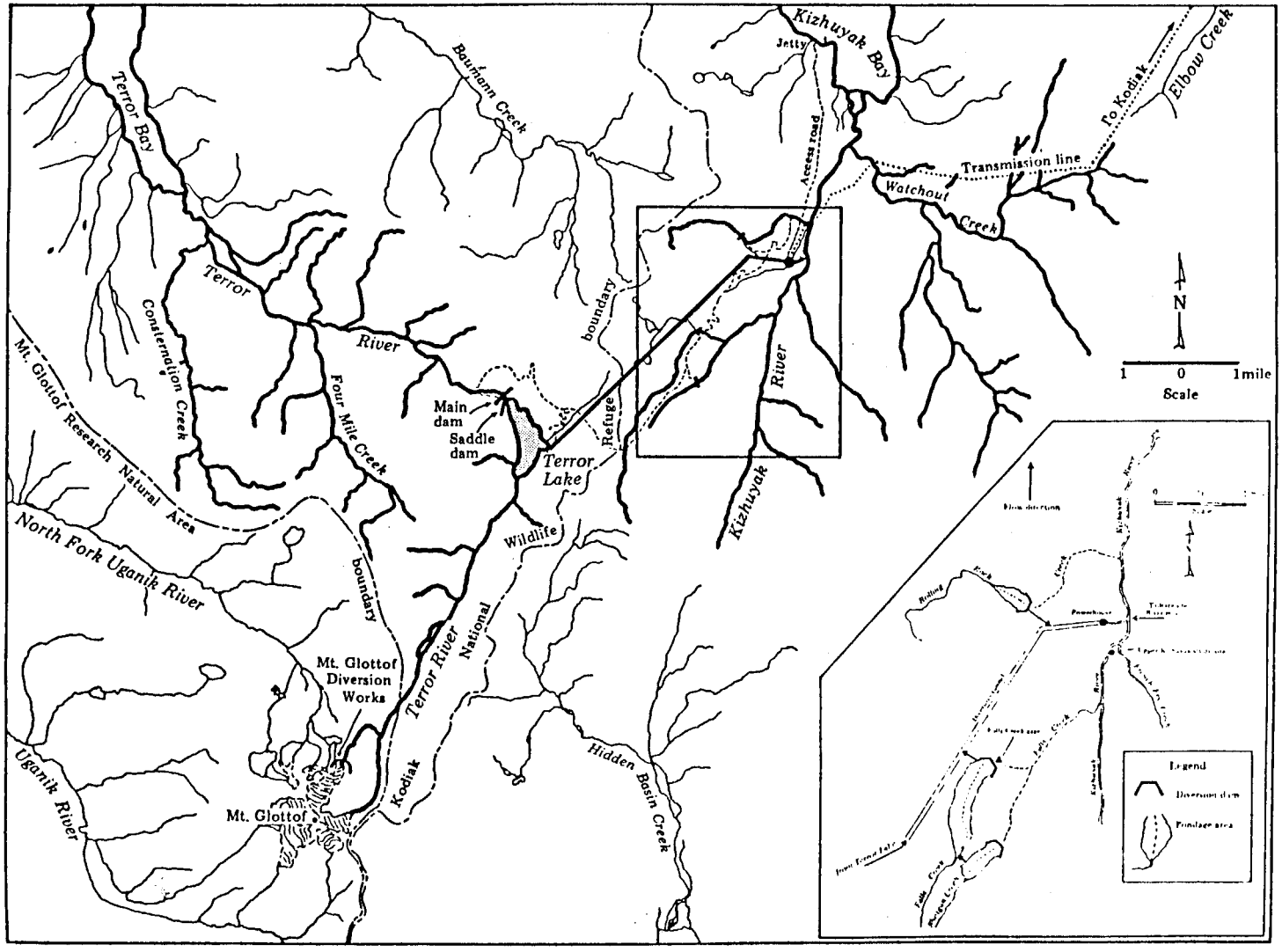


Figure 3. Terror River pre-emergent fry sampling sites, 1987.

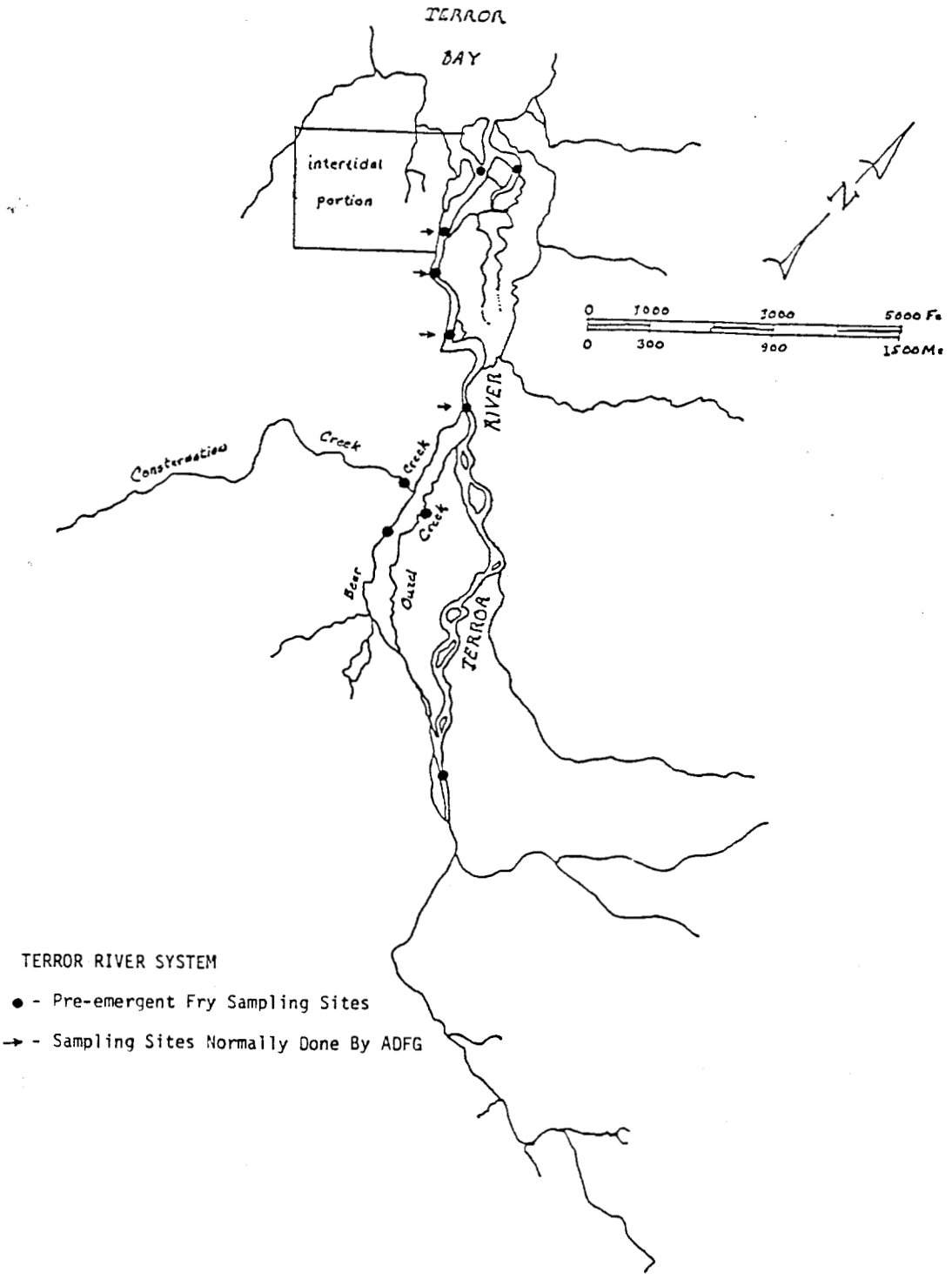


Figure 4. Kizhuyak River pre-emergent fry sampling sites, 1987.

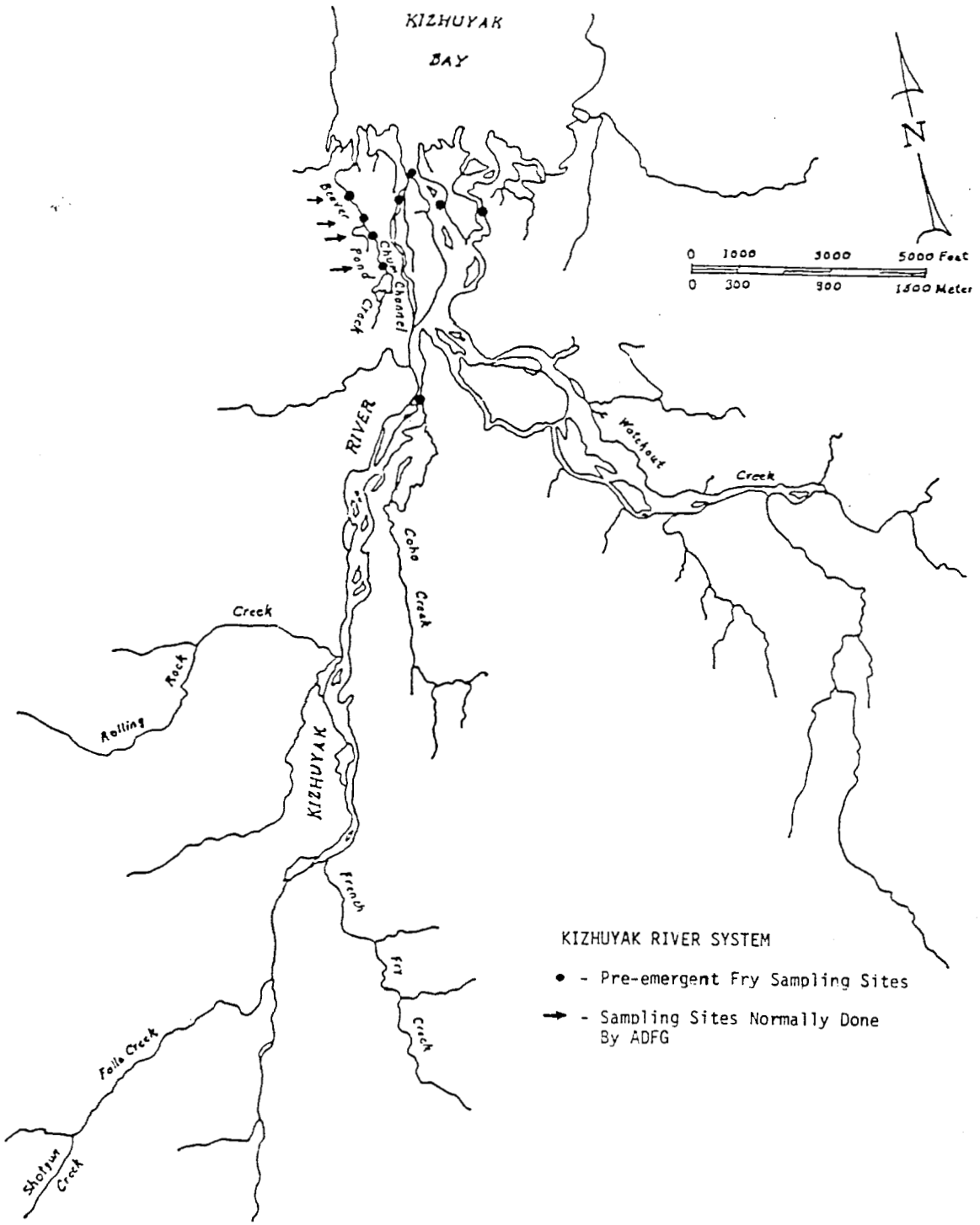


Figure 5. Terror River pink salmon distribution, 1987.

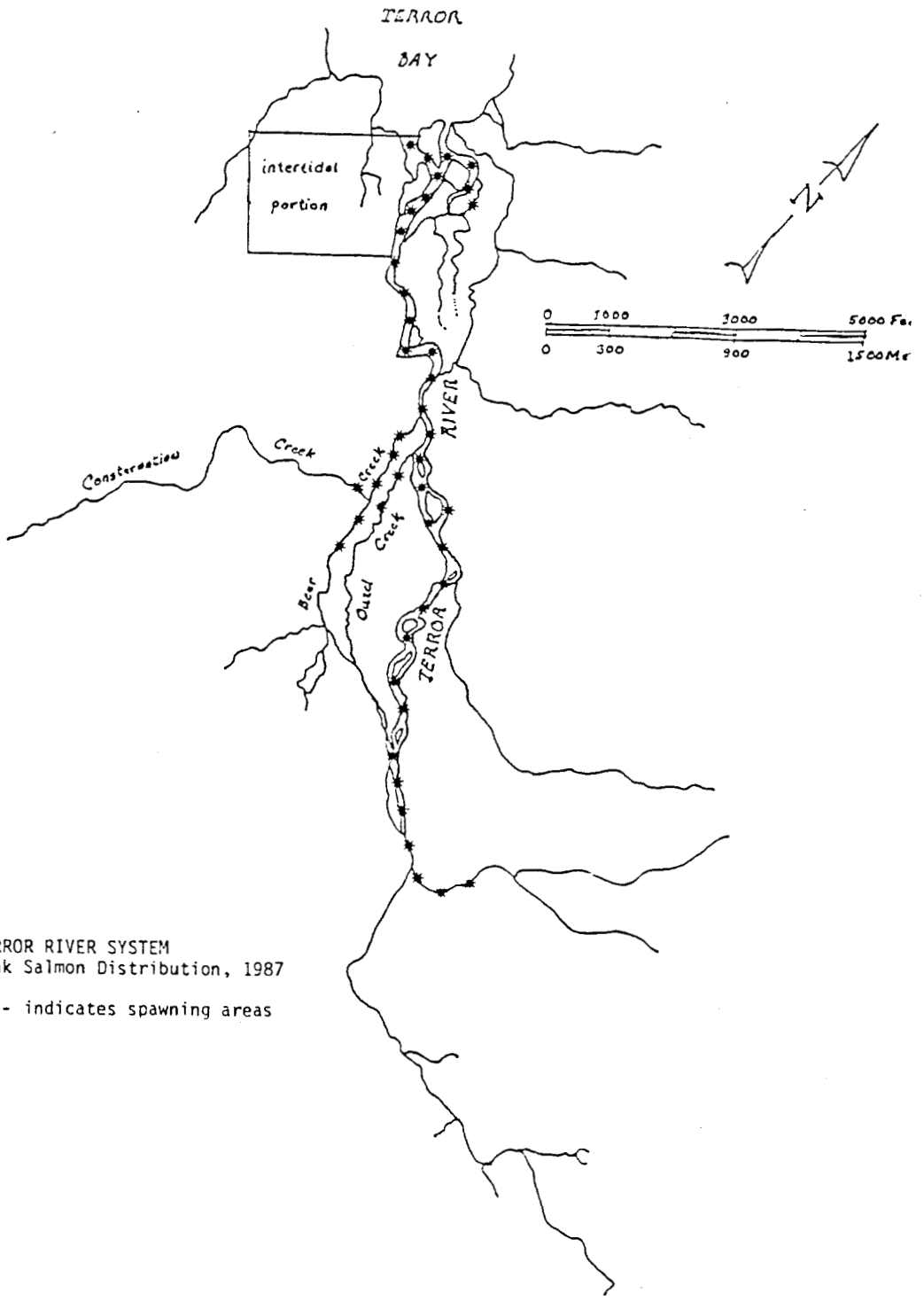


Figure 6. Terror River chum salmon distribution, 1987.

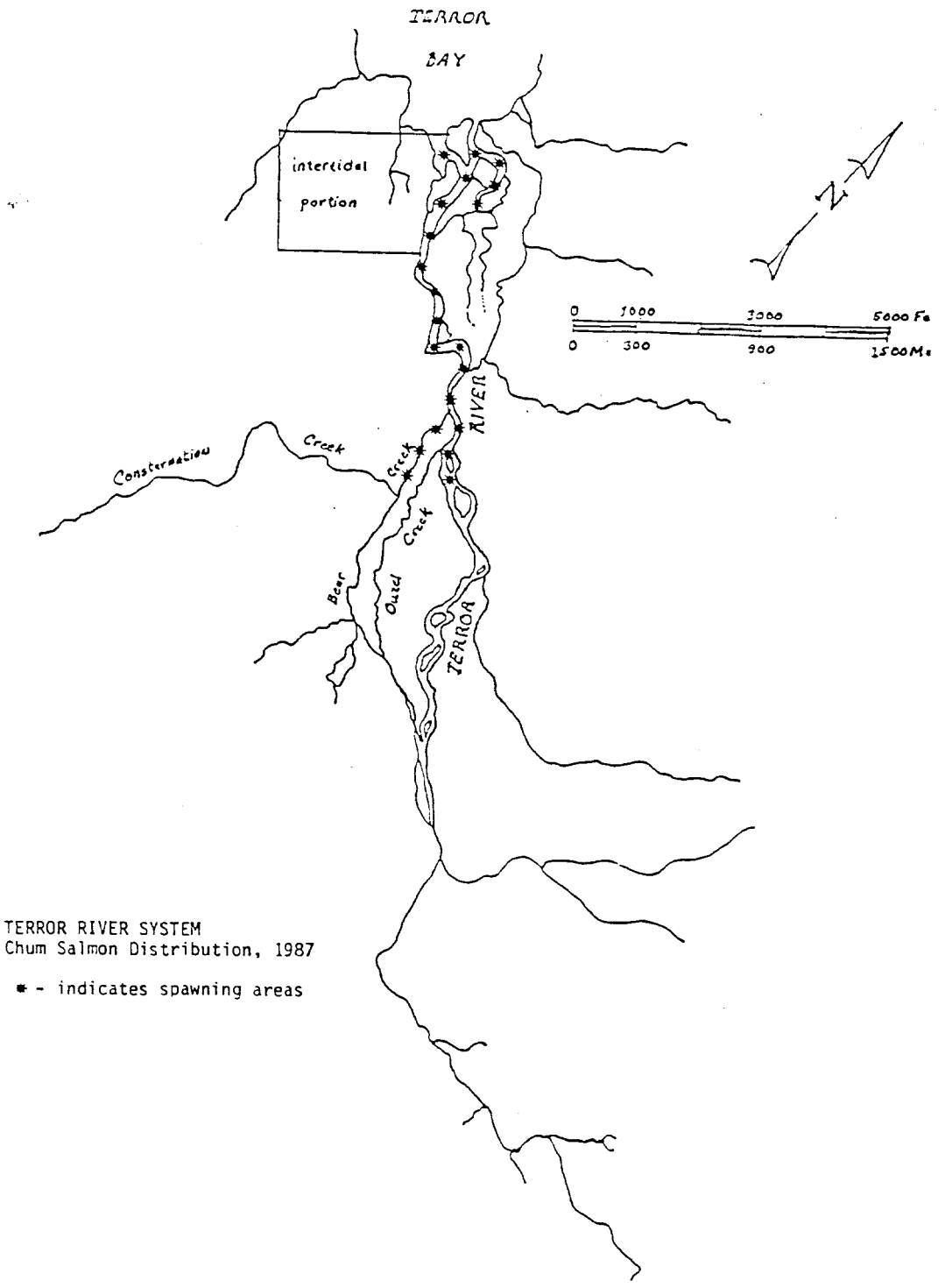


Figure 7. Kizhuyak River pink salmon distribution, 1987.

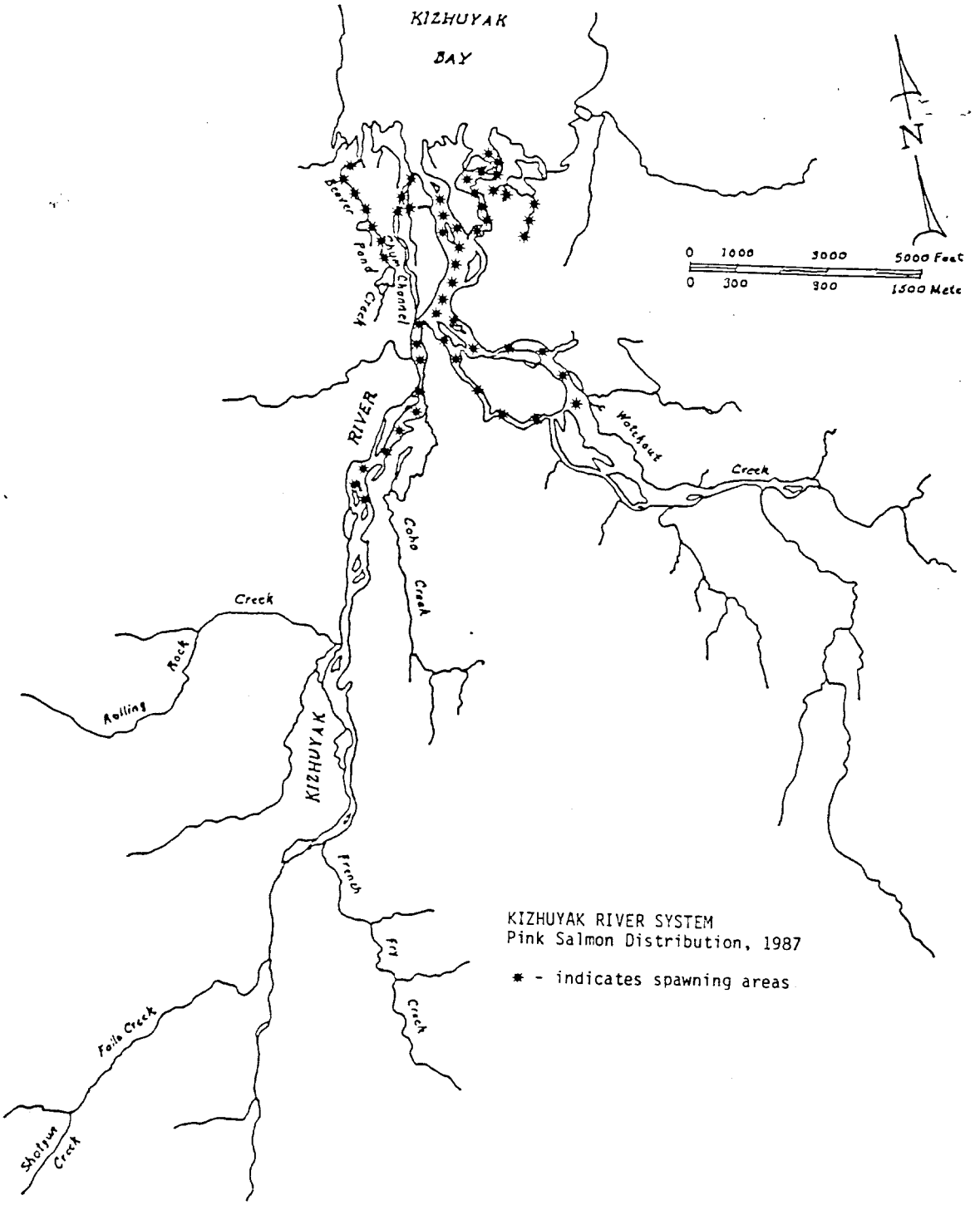
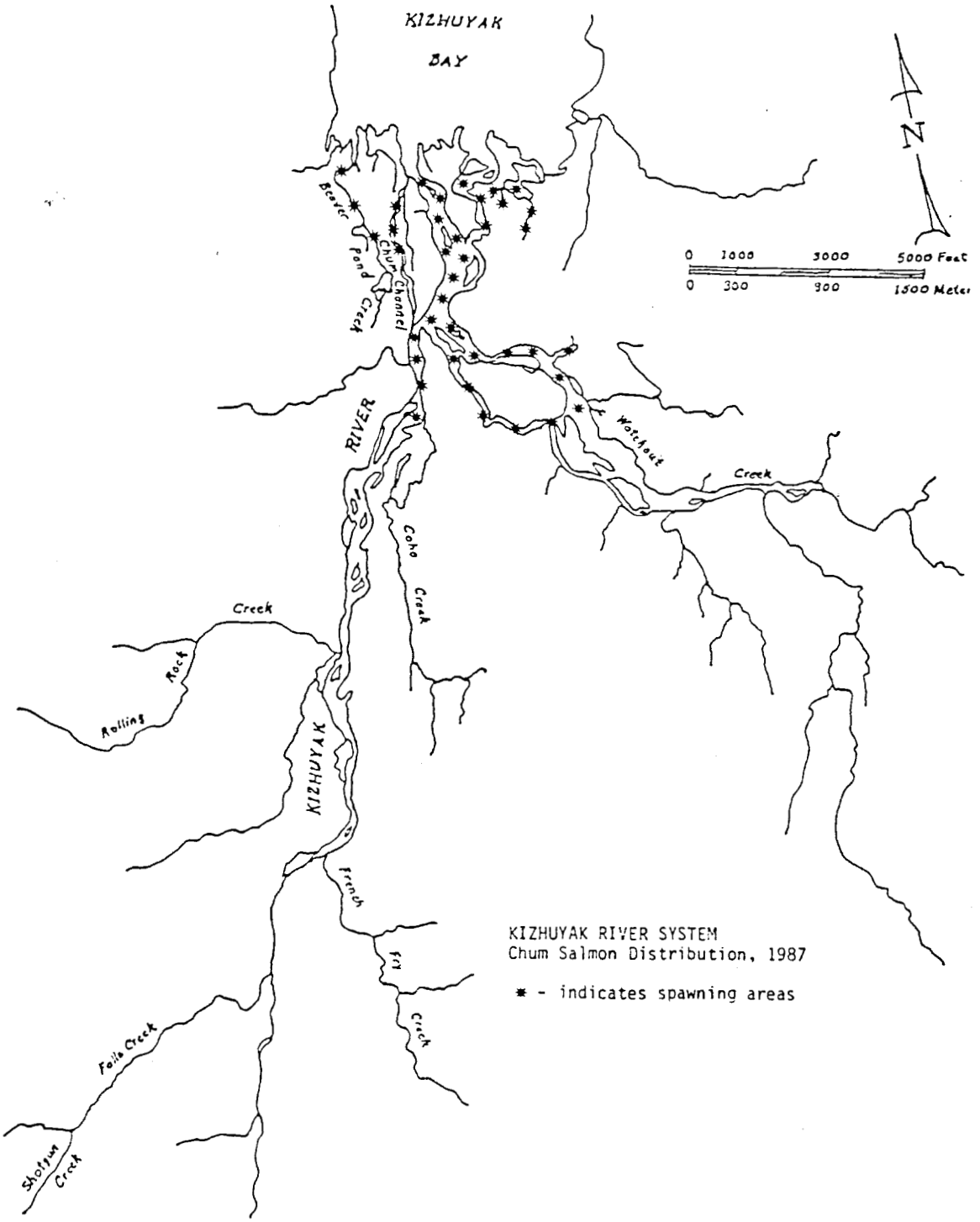


Figure 8. Kizhuyak River chum salmon distribution, 1987.



LITERATURE CITED

AEIDC (Arctic Environmental Information and Data Center). 1981. An assessment of environmental effects of construction and operation of the proposed Terror Lake hydroelectric facility, Kodiak, Alaska. Final Report, University of Alaska, Anchorage.

Malloy, L. 1981. Project Proposal: Kizhuyak River and Terror River salmon studies. Unpublished Report; Alaska Department of Fish and Game, Kodiak.

Appendix A. Commercial Fisheries Division expenditures, Terror River Hydroelectric project, 1987.

CAPITAL IMPROVEMENT
Balance Sheet

LINE ITEM	TOTAL ALLOCATIONS	EXPENDITURES	YEAR TO DATE EXPENDITURES	TOTAL ENCUMBRANCES	ENCUMBRANCE BALANCE REMAINING	BALANCE REMAINING	PERCENT SPENT
000 - Unallocated	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.00
100 - Personnel	$20,400.00	$21,489.00	$21,489.00	$0.00	$0.00	-$1,089.00	105.05
Not designated		$0.00	$0.00				
Permanent/Full		$0.00	$0.00				
Permanent/Seas		$21,489.00	$21,489.00				
Non-Permanent		$0.00	$0.00				
200 - Travel	$300.00	$0.00	$0.00	$0.00	$0.00	$300.00	0.00
300 - Contractual	$13,000.00	$3,242.00	$0.00	$0.00	$0.00	$9,758.00	24.94
400 - Commodities	$1,450.00	$60.00	$60.00	$0.00	$0.00	$1,390.00	4.14
500 - Equipment	$375.00	$0.00	$0.00	$0.00	$0.00	$375.00	0.00
Lines 200-500	$15,125.00	$3,302.00	$3,302.00	$0.00	$0.00	$11,823.00	21.83
TOTAL - All lines	$35,525.00	$24,791.00	$21,791.00	$0.00	$0.00	$10,734.00	69.78